NATURAL RESOURCE CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

(Ft)

CODE 620

DEFINITION

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.

SCOPE

This standard applies to underground conduits designed to dispose of excess surface water. It does not apply to trickle tubes or to principal spillways in PONDS (378) or in SUBSURFACE DRAINS (606).

PURPOSE

To dispose of excess water from terraces, diversions, sediment and water control basins, debris basins, subsurface drains, or other concentrations without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where: (1) excess surface water needs to be disposed of; (2) a buried outlet is needed for DIVERSIONS (362), TERRACES (600), or similar practices; (3) an underground outlet can be installed that will safely dispose of excess water; (4) surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic; and (5) water will not be ponded permanently.

DESIGN CRITERIA

The underground outlet shall be designed alone or in combination with other practices, with adequate capacity to insure that the practice functions according to the standard for the specific practice. For example, an underground outlet can be used in combination with a grassed waterway to reduce the frequency, duration or amount of flow in the waterway.

Each underground outlet will be designed according to the following classification system.

A Class 1 underground outlet is used to provide the outlet for terraces, diversions, water and sediment control basins and similar practices where there is sufficient surface storage available to meet the proper flood routing requirements given in Table 1.

A Class 2 underground outlet is used to provide a full flow outlet from a diversion, waterway, or similar practice where there is no significant amount of surface water storage available.

A Class 3 underground outlet may be used in combination with a vegetative outlet to reduce the frequency and duration of prolonged low flows through the vegetative outlet. The prolonged low flow may be the result of baseflow, outflow from a small upstream structure or irrigation tailwater. The vegetative outlet is designed as the principal outlet for the specific practice. This classification does not apply to dams, ponds or structures.

A. Class 1 Underground Outlet Design Criteria

Table 1. Simplified Flood Routing for Underground Outlets

Duration of flooding	Design outflow	Water storage
(hrs removal time)	(cfs/ac-in. of runoff)	(fraction of total runoff to be stored)
6	0.10	0.70
12	0.070	0.79
18	0.050	0.85
24	0.037	0.89
36	0.026	0.92
48	0.020	0.95
72	0.014	1.00

The normal release time from practices on farmland is 24 hours. The time for removal of runoff may be adjusted to not less than 6 hours nor more than 72 hours following the storm period. In no case should the conduit be less than 3 inches in diameter.

B. Class 2 Underground Outlet Design Criteria

A Class 2 underground outlet will be designed with discharge capacity equal to or greater than the peak design flow rate of the practice providing flow to the Class 2 outlet.

C. Class 3 Underground Outlet Design Criteria

A Class 3 underground outlet may be used in combination with vegetative outlets to reduce the frequency and duration of low flows through the vegetative outlet. The underground outlet will be designed with capacity equal to or greater than the rate of prolonged low flow. Maximum pipe diameter for this purpose will be 18 inches. This paragraph does not apply to vegetative spillways for dams, ponds or structures.

D. Discharge Capacity - All Classes of Outlets

The underground pipe conduit shall be sized and placed on grades to conduct the designed release from the terrace(s), diversion, debris basin, or other practice as nonpressure flow, except the outlet section below the bottom terrace may be designed for pressure flow, providing corrugated plastic tubing or perforated conduit is not used. Maximum permissible velocities are listed in Table 2 below.

Table 2. Maximum Permissible Velocities in a Conduit Line (ft/sec)

Soil texture	Perforated corrugated plastic tubing	Nonperforated corrugated plastic tubing	PVC (smooth), smooth steel, corrugated steel, concrete pipe
Sand & sandy loam	3.5	8.0	No limit
Silt; silt loam	5.0	10.0	No limit
Silty clay loam; clay & clay loam	7.0	12.0	No limit

When the conduit size needs to be increased because of additional inflow volume or reduced grade, the transition should be not less than five diameters upslope from the feature causing the increase.

E. Materials

The underground conduit may be smooth plastic pipe, corrugated plastic pipe, corrugated metal pipe, smooth metal pipe, or concrete pipe and will be used within its limits for loading and permissible velocities.

The smooth plastic shall be polyvinylchloride, meeting one of the following: ASTM D-1785, D-2241, D-3033, or D-3034. Minimum wall thickness shall be in accordance with Table 3, depending on maximum fill over the pipe.

ASTM	Title
D-1785	Spec. for PVC Plastic Pipe Schedules 40, 80, & 120
D-2241	Spec. for PVC Plastic Pipe SDR-PR
D-3033	Spec. for Type PSP PVC Sewer Pipe and Fittings
D-3034	Spec. for Type PSM PVC Sewer Pipe and Fittings

Refer to Chapter 17, pages NB-17-32 a through e, Engineering Field Manual for additional information about Plastic Pipe.

TABLE 3: MAXIMUM FILL OVER SMOOTH (INTERIOR & EXTERIOR) PLASTIC PIPE OR CORRUGATED EXTERIOR (SMOOTH INTERIOR) PIPE INSTALLED IN A TRENCH

MAXIMUM HEIGHT OF FILL OVER CONDUIT(FT).....BASED ON E=400,000						
NOMINAL DIA(inches)	*ps *PR *SDR	14 psi 80 psi 51	28 psi 100 psi 41	57 psi 125 psi 32.5	114 psi 160 psi 26	224 psi 200 psi 21
			(**)		(***)	
4		9	11	13	16	20
5		9	11	13	16	20
6		7	11	13	16	20
8		7	9	10	14	16
10		5	7	10	13	14
12		5	7	10	13	14
15		-	5	8	12	13
16		-	5	8	12	13
18		-	5	8	12	13

* Either PR (Pressure Rating) or SDR (Standard Dimension Ratio) must be stamped on the pipe as part of the manufacturer's identification. Corrugated exterior (smooth interior), plastic pipe is rated by pipe stiffness (PS) rather than pressure ratings and the PS will be stamped on the pipe or identified in the manufacturer's product literature.

** Use this column to determine allowable fill height for corrugated exterior (smooth interior) pipe stamped ASTM F-949 or AASHTO M-294.

*** Use this column to determine allowable fill height for corrugated exterior (smooth interior) pipe stamped ASTM F-892.

Maximum fill height over corrugated (exterior & interior), flexible, plastic tubing shall be 10 feet above the top of the conduit. The minimum depth of trench is tubing diameter plus 12 inches.

Specifications describing corrugated (exterior & interior), flexible, plastic tubing:	
ASTM F-405	(PE, 3-6" diameter)
ASTM F-667	(PE, 8-24" diameter)
AASHTO M-252	(PE, 8.15" diameter)
AASHTO M-294; Type C or CP	(PE, 12-24" diameter)
ASTM F-800	(pvc, 4-12" diameter)

Specifications describing corrugated exterior (smooth interior), plastic pipe:	
ASTM F-892	(PE, 4" diameter only)
AASHTO M-294; Type S or SP	(PE,-12-24" diameter)
ASTM F-949	(pvc, 4-18" diameter)

Concrete pipe shall be the bell-and-spigot type, meeting the requirements of ASTM C-14, Class 2 or better, for nonreinforced concrete pipe, or ASTM C-76, Class 2, for reinforced concrete pipe.

F. Inlets

Class 1 inlets for terraces and water and sediment control basins will be perforated-pipe risers, slot-perforated precast concrete boxes, or similar construction with slots or holes in the drawdown area.

An orifice will be used when it is necessary to control (restrict) the release rate and/or to prevent pressure flow. The controlled release rate is usually necessary in lines with more than 1 riser per line.

The orifice plate will be at the lower end of the riser, sized as needed to control the release rate. A 2 inch diameter orifice will be the minimum size used.

The capacity of the riser with 1 foot of head shall exceed the flow through the orifice. The minimum diameter of a riser shall be 6 inches or 1.5 times the orifice diameter, whichever is greater.

The riser shall extend a minimum of 0.5' above the design storage elevation or 5' above the channel grade at the riser whichever is less and be protected by guard post(s), when necessary, and have a cover or lid. The riser should be connected to the main line by a tee and an elbow as a minimum. A 4-ft or longer horizontal pipe between the main line tee and the riser elbow is recommended for all types of pipe installations and is required for corrugated plastic-pipe installations. If fire is a hazard, the inlet shall be fire-resistant.

Class 2 and Class 3 inlets may be either slotted inlets or open inlets with trash guards as needed to prevent them from being plugged with trash. The minimum size pipe for open inlets shall be 8" diameter for pipes without elbows and 12" diameter for pipes with elbows.

G. Outlets

The outlet section of the underground outlet(s) shall be located where damage to the outlet area is minimized and erosion will be controlled. A minimum of 10 feet of the outlet section will be a rigid pipe. If fire is a hazard, the outlet shall be fire-resistant.

PROTECTION

Before the outlet is installed, all disturbed areas shall be reshaped and regraded so that they blend with the surrounding land features and conditions. Visual resources must be given the same consideration as other design features. Areas that are not to be farmed or covered by structural work shall be established to vegetation or otherwise protected from erosion as soon as practicable after construction.

MAINTENANCE

Underground outlets shall be maintained by keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow. All leaks shall be repaired promptly to insure proper functioning of the conduit. Rodent guards must be inspected periodically and maintained in proper working order. Additional maintenance instructions are given on Eng. Specifications MAINTENANCE OF UNDERGROUND OUTLETS, page S-620-6.

PLANS AND SPECIFICATIONS

Plans and specifications for installing underground outlets shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose.

Open inlets will be as shown in Nebraska base drawings. Use of diaphragms are optional with this practice.